

## Background

- The *LigaSure Maryland Jaw Open and Laparoscopic Sealer and Divider with Nano-coating* is an industry leading, single-use surgical device for everyday clinical practice
- The jaws grasp, cut, dissect and reliably seal tissues and vessels using RF energy
- Medtronic currently uses a single force measurement at 17° to analyze their devices and wants exploratory research into pressure distribution across the jaws at smaller angles

## Objectives

- ✓ Determine if Interlink Electronics UX 400 Round Force Sensing Resistors (FSR) are a viable and reliable option for measuring pressure at the Maryland LigaSure Jaw's scale
- ✓ Develop a universal calibration curve for FSRs to convert force to voltage
- ✓ Design a repeatable test setup to gather data from a Maryland LigaSure device
- ✓ Achieve insight into how the Maryland LigaSure device's jaws behave at small angles with operator variation at two separate locations (proximal and distal)

## Design Approach

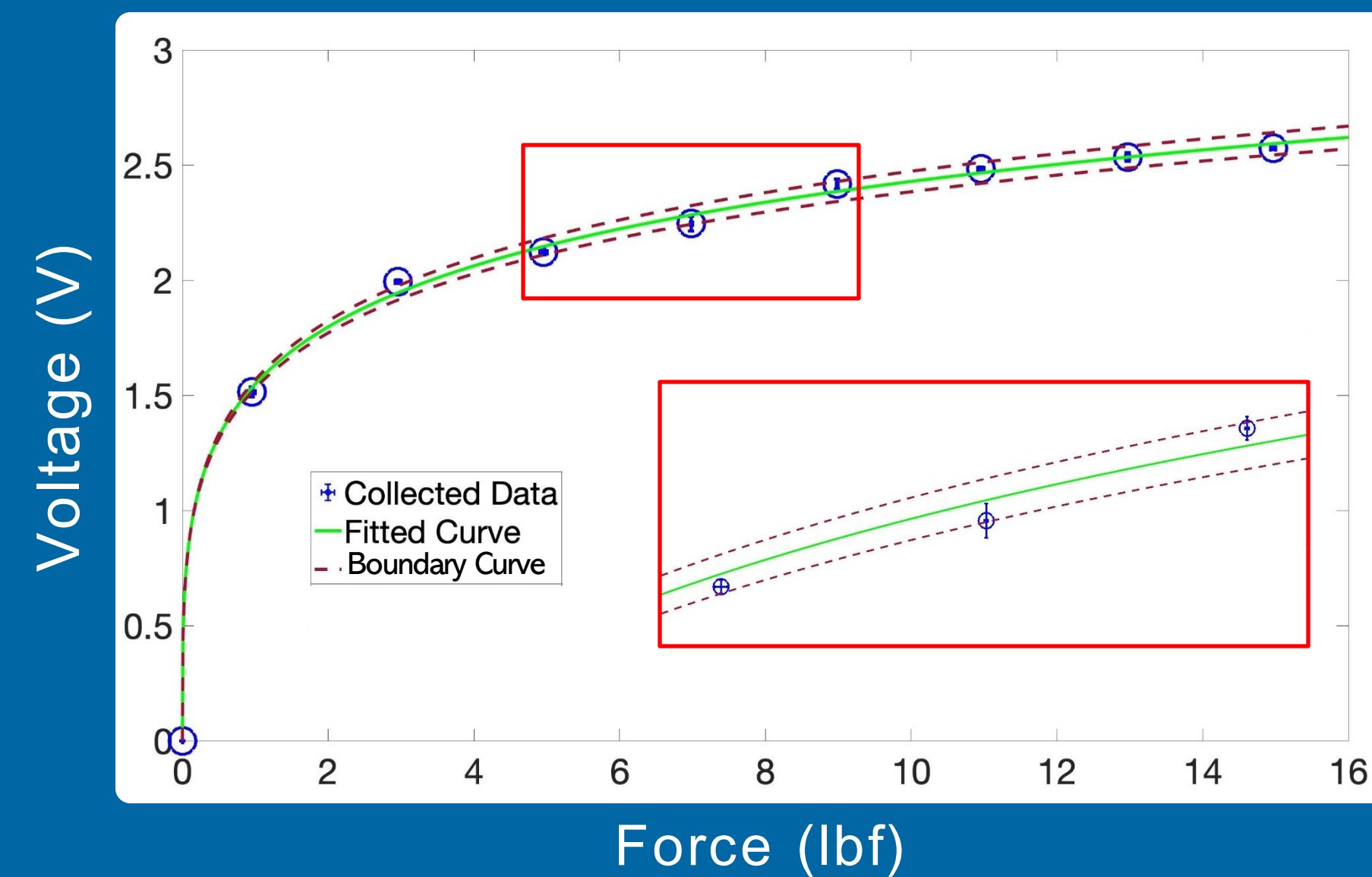


## Calibration Curve

### Testing Requirements

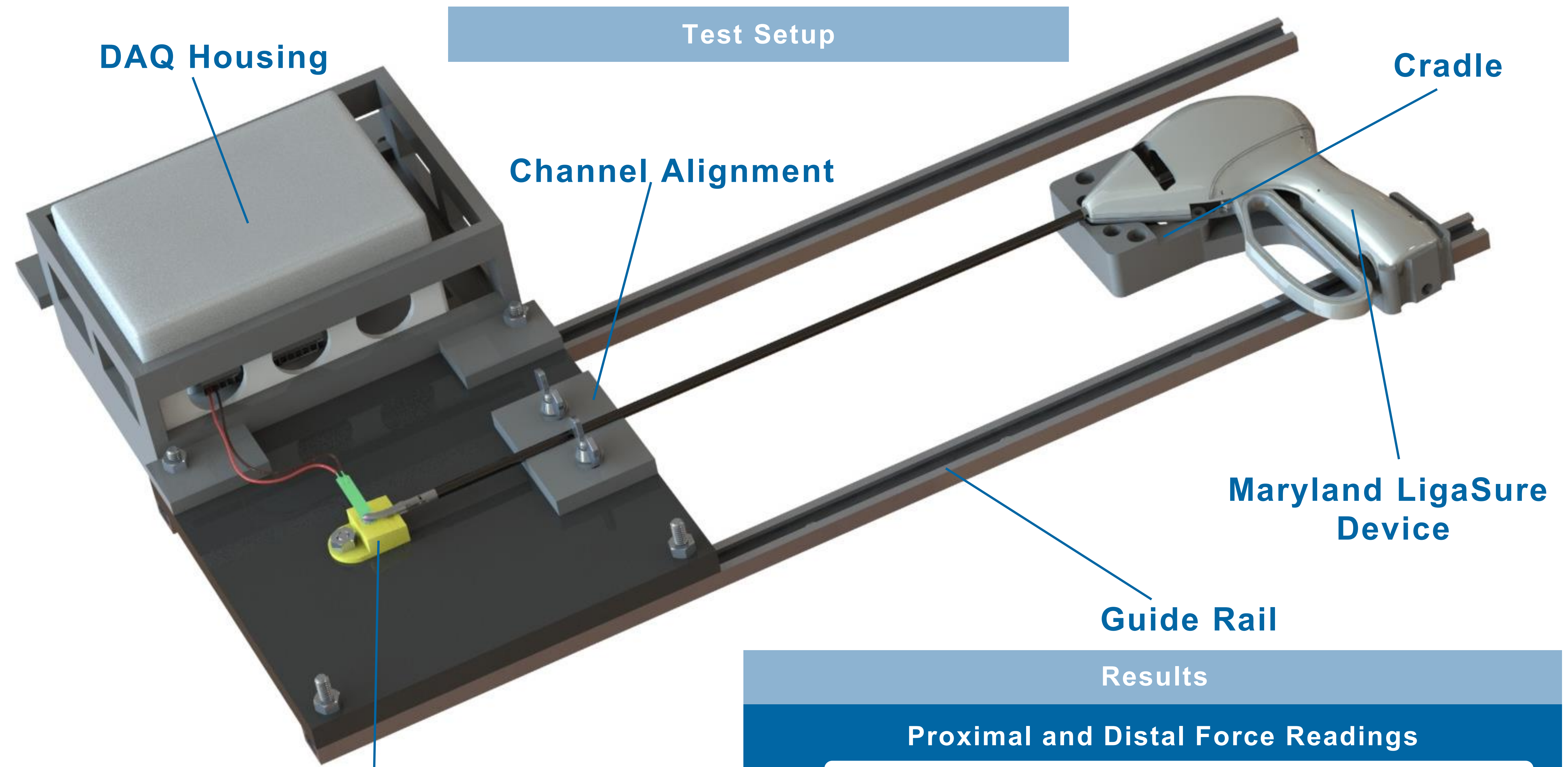
- ✓ Universal calibration curve for both proximal and distal locations
- ✓ Force range is 0 - 15 lbf
- ✓ Verify sensor reliability
  - ✓ High FSR repeatability
  - ✓ Negligible drift
  - ✓ Uniform sensor de-loading

### Universal Calibration Curve

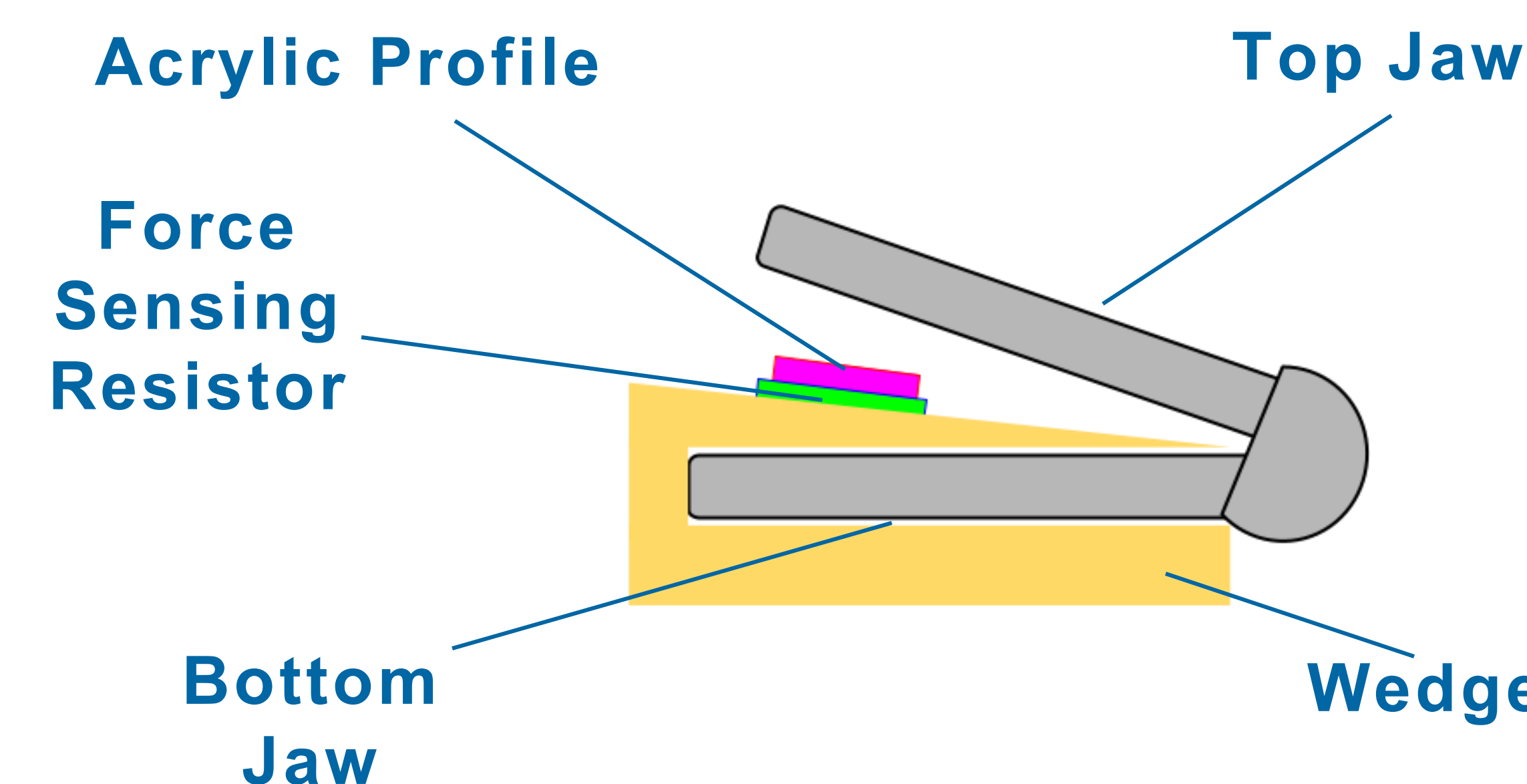
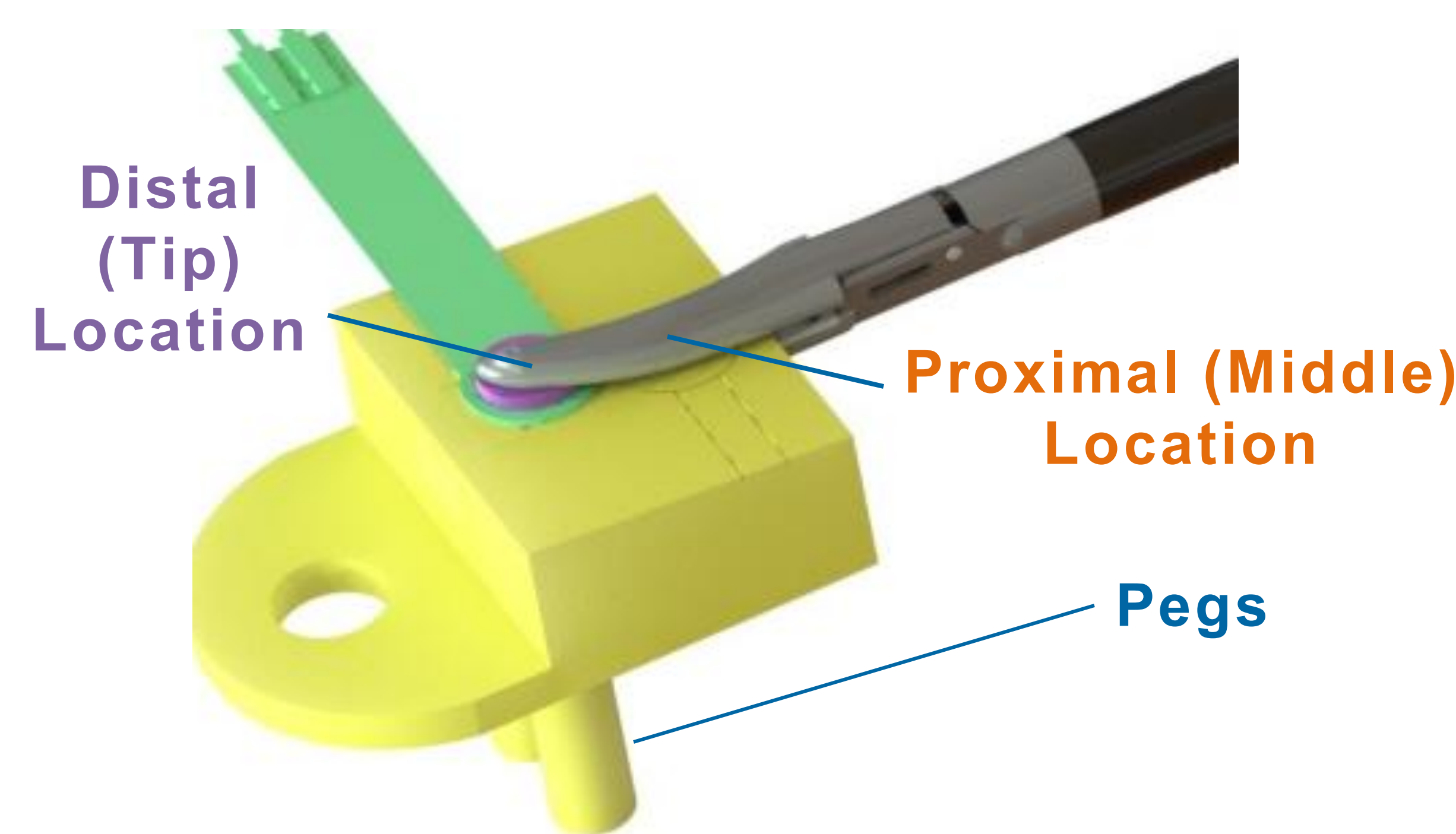


## Test Setup Design

- Data Acquisition (DAQ) housing holds our NI USB-6008, breadboard, and circuitry
- Alignment features such as the channel, cradle and guide rails hold test setup level ensuring repeatable data collection and testing
- Wedge Design
  - Pegs secure plate interface and restrict rotation during testing
  - Front slot houses and stabilizes the bottom jaw for consistent results
  - Location etchings establish consistent sensor placement and orientation
  - SLA material provides high strength and manufacturability while also having low ductility
- Proximal and distal locations
  - Two locations characterize the pressure at the middle and tip of the jaw; which is more comparable to clinical use
  - Two wedges tested with individual proximal and distal locations respectively
  - 4° incline simulates clinical usage

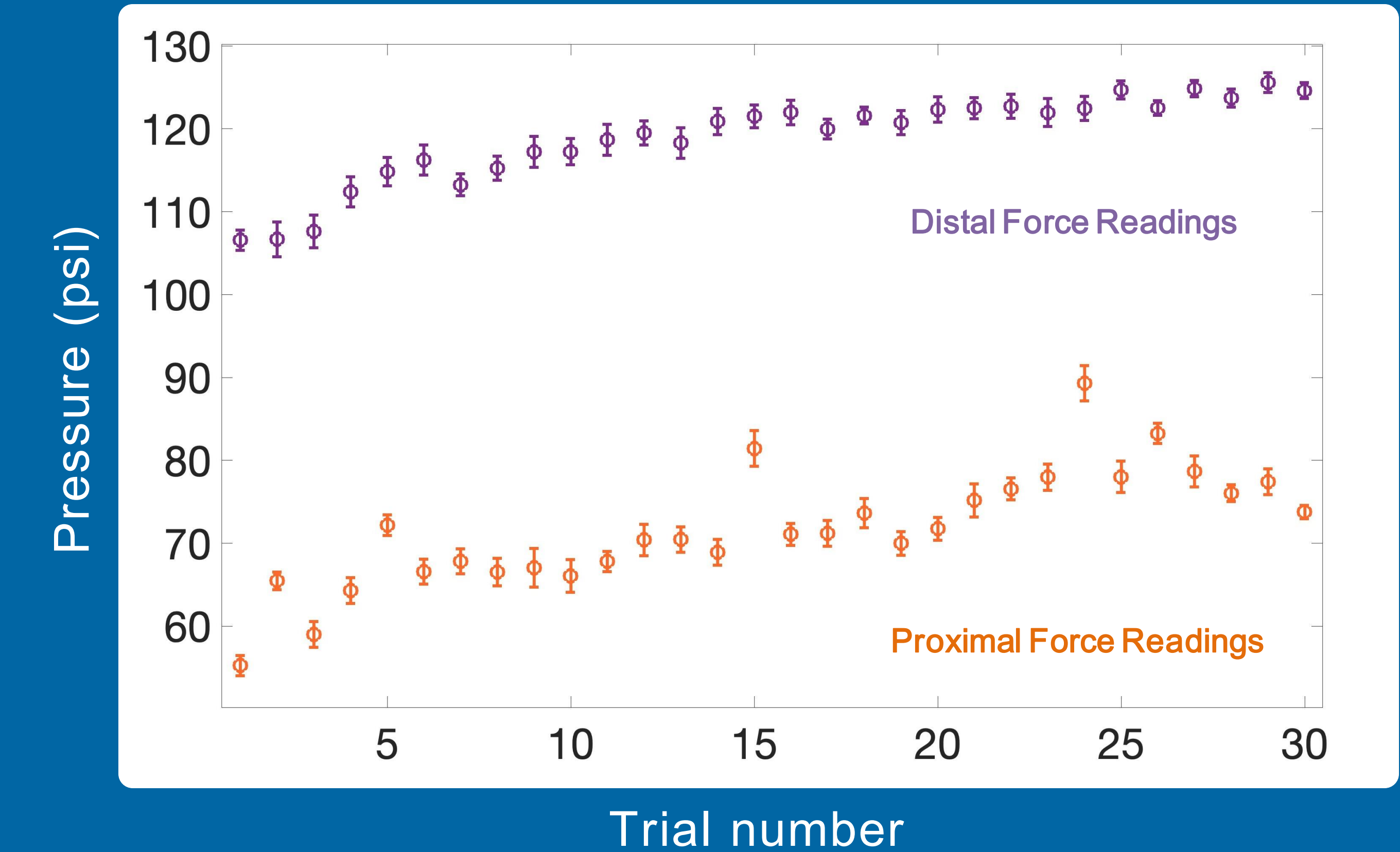


## Wedge



## Results

### Proximal and Distal Force Readings



- Pressure readings differ between sensor locations along the jaw:

Distal Data Average: **146 ± 27 psi**      Proximal Data Average: **75 ± 14 psi**

- Each LigaSure Maryland device behaves differently
- Individual device readings differ based on number of actuations and the device's "age" in its product lifetime

## Conclusions

- FSRs are a viable and repeatable way to measure pressure in the jaws
- Our test setup and system provides reliable pressure distributions for the Maryland LigaSure devices
- This project provides Medtronic with additional information to quantify sealing pressure distributions at small angles